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The inadequacy of the American public school system can only be remedied by an opportunity to make radical changes in educational techniques and institutions. It is the elected official, not the educator, who makes the basic educational policy that is mediocre and rigid. Most educators have had little experience with developing a cohesive program using modern technology and materials. A systems analysis approach to the present problems could be of value. Individually prescribed instruction (with clearly defined goals) might be a legitimate strategy. Regional educational laboratories and a national organization for educational development could help systematize and distribute information on innovations in learning techniques. To be effective these institutions must be willing to try unfamiliar approaches and to continually review the accepted methods and standards. Appended to this essay are: a list of extant regional educational laboratories; a short paper on their accomplishments in computer and non-computer technology, and computer administrative technology; and a paper on the Research for Better Schools, Inc. (RBS) approach to automated learning. (JY)

EMERGING TECHNOLOGY SYSTEMS

PROFESSIONAL PAPER

RUN COMPUTER RUN: A CRITIQUE

RESEARCH FOR BETTER SCHOOLS INC.

ED031081

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RUN COMPUTER RUN: A CRITIQUE

by

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For the Conference on Information Technology
and Secondary Education

May 1-2, 1968

Harvard University

Program on Technology and Society

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RUN COMPUTER RUN: A CRITIQUE

It is quite easy for one who has visited the well of technology to agree with the author(s) of Run Computer Run. After all, visions and dreams are easy to come by; it's understanding the problems of reality that's hard.

I, too, have had a vision. Hopefully, the vision went, we could begin to replace the colonial dame teacher with the new technology. The worst thing that could happen - so went the vision - would be that kids might enjoy learning. Spurred by the fantasy, I wrote an article on the subject in 1966. Unfortunately for the vision, the conclusions I reached were not dissimilar from those presented in Run Computer Run.

> "Yes, the new technology has discovered that education is big and a rapidly changing business; no, the impact of technology on education will not be as rapid as many people suppose.
>
> Change in education is more apt to be evolutionary than revolutionary because:
>
> - Technology is in competition with the role of the teacher.
> - Education and technology promise more than they deliver today.
> - The majority of existing educational institutions have been designed for stability of operation and not for rapid adaptation and change.
> - The commitment in dollars required to accelerate the pace of change appears to be more than we are willing to pay.
>
> For these reasons, most of the schools of 1970 through 1980 will still look much like they do today."[1]

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[1] James W. Becker, "It Can't Replace the Teacher - Yet", Phi Delta Kappan, Vol. XLVIII, No. 5 (January 1967), pp. 237-239.

The word essay, as defined in the New Random House Dictionary, is a short literary composition on a particular theme or subject, usually in prose and generally analytic, speculative, or interpretative. Run Computer Run meets all of the criteria with the exception of brevity. Much of what is written could have been said with fewer words; lengthy word games and semantic tricks tend to distract from the valuable content of the essay. Applying the principle of economy to the essay - that is continually to reduce the verbiage to a point beyond which it would lose meaning - would enhance its cogency.

GENERAL REACTIONS

Perhaps the best place to begin a critique is to touch the current reality of American schools. Intellectual assumptions about what schools are or are not do not bring reality into focus.

A Touch of Reality

Whether technology will bring glowing changes to the schools of America is almost irrelevant when it is weighed against the reality of now! One does not have to be coy about an un-named "Small City" or a Watertown, Massachusetts; or use Kozol or Up the Down Staircase to make a devastating point. The facts are more devastating.

Take a real city, Newark, New Jersey, which has had a great deal of publicity and several extensive reports written about it, to bring reality into proper focus. Here are some of the public facts about Newark, New Jersey, as reported by the Governor's Commission.[1]

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[1] Report for Action, Governor's Select Commission on Civil Disorder, State of New Jersey, February 1968.

- The 76,000 pupil public school system is in such an "advanced state of decay" that only the state's taking over and running it can offer any hope for improvement.
- Mayor Hugh J. Addonizio "heartily endorsed" a state takeover and offered his help in making the transfer quick and easy.
- One-half of secondary pupils are or will be functionally illiterate when they complete their high school education.
- In grade seven, Newark's average on the Stanford arithmetic test was 5.1, compared to the national norm of 7.2.
- The dropout rate from 1962-1966 (cumulative) was 32 per cent.
- The public school system is $250 million behind in capital construction, yet the city and school board have reached legal bonding limits.
- 30 of the 75 buildings were constructed before 1900; 44 are more than 50 years old.
- 35 of the 50 elementary schools are operating at from 101 to 151 per cent of capacity.
- 28 per cent of the children leave Newark's system each year for suburban or parochial schools; they are replaced by southern Negro immigrants and Puerto Ricans from New York City.
- Howard J. Ashby, president of the Newark Board of Education, testified: "I think somewhere along the line someone has to say 'Stop.' This is it. We are not doing a good job, professional educator or layman, and say these are the facts. Until such time as these reading levels and arithmetic levels come up, there isn't anyone who can say in the City of Newark, professional or otherwise, we are doing a good job because these children just can't read and do arithmetic. Until they are able to accomplish that on a broad base and we have more than six out of every 100 above

> the national norm, I don't think we can say that we are doing a good job . . . . . What I want to do is put the facts on the table without any cover-up because I think this is the time to do it . . . . . I think we are going to have to call a sharp halt to all of the camouflage that has gone on for the past 10, 15 and 20 years."

Needless to say, Newark is in serious danger of losing a majority of its teachers.

Take the 100 largest cities in the United States and use Newark as a base multiplier. It can be documented, almost to the same degree, that a state of advanced decay now exists in the public schools which enroll the majority of those who attend school.

See the sharp contrast in our American values! Within 1,000 days it is highly probable that the first man from the United States will walk on the surface of the moon. While he is performing this costly act, the children of America will be attending their factory schools, many of which were built in the 19th century, most still ignoring the technology of the 20th century, but all of them preparing children to live in the 21st century now only thirty-two years away.

Economy and the Schools

Anyone can be pessimistic about our schools of today, but the point that many people miss, including the author of Run Computer Run, is that society gets pretty nearly what it wants. For years the real operational goal of those who control public education has not been to have good schools, but to have schools that are just good enough.

Run Computer Run apparently takes for granted that public school administrators have somehow failed to act in the past or change in the present because of some unknowing blindness to the facts of the life of the deprived in our society. If one accepts this belief as accurate, he must be led into believing that some new act of will by the public school can set the matter right, in time. But the belief is quite invalid and, as a basis of planning, dangerous.

The truth is rather that the same social forces which have burdened our cities with the frustrations of poverty and unemployment have also burdened the city school systems with a scarcity of resources and the disadvantages of an untroubled conscience. Is it possible to believe, for example that it is only accidental that in every state the school subsidy formulas have always discriminated against the cities? Is it possible to believe that the cities' big taxpaying corporations, whose owners and managers almost always live in the suburbs, have really wanted to pay taxes to support schools at levels high enough to remediate the social, economic and educational disadvantages of their employee's children? Is it possible, to be nasty about it, that the small band of congressmen who control Washington's public schools have really troubled themselves with the decades of evidence that Washington's schools were shamefully inadequate to the needs of Washington's poor?

No, it is only possible to believe that the cities' public schools are, on purpose, no better than the people who control money and power have wanted them to be. True, there have always been enough school superintendents and principals who have been willing to accept the constraints imposed upon them, but it would be a gross error to assume that it has ever been, or is now, within the power of professional educators to make school systems much different from what their boards of control and those who control them decide. Educators do not make basic educational policy.

This is a fact of central importance, not only because it argues for a different strategy of analysis, but because it helps to distinguish among the several kinds of possible educational improvement.

In this same context it can be understood why only a dozen years ago the dollar investment in educational research was, in Clarke's phrase, "as zero." Sure, there has been a failure by schools and by the industries that serve them to invest money in research, development and technology, because there has not been the kind of money these intrinsically expensive ventures require; and require, as a matter of fact, in long-term time. If there is a note of hope today it is that these money deficiencies are beginning to yield to the forces of desperation. We are investing real money in curriculum construction, in research and development, in exemplary programs. Not enough yet, but we are beginning.

Of course, agreeing with Oettinger's pessimism about education money is easy. After all, anytime we try to make up long-term deficits with crash programs the costs must appear to be staggering, to be impossible. If we had been evolving toward an eighty-two billion dollar education expenditure by 1975, so that we were now spending at, say, the sixty-five or seventy billion level, there would be no pessimism about economics. The pessimism is really about the past, not the future. All our school system history not only argues against being able to get eighty-two billion in 1975, but even more disconcertingly, against our being able to spend that much wisely, even if we could get it. School people have no experience in being able to spend at optimum levels.

Run Computer Run does advance two interesting examples for speculation. What would be the state of education and technology now if education had been granted the same conditions under which the Rand Corporation and the Bell

Telephone company operated? Rand, with a ten-year developmental time, and Bell, with a massive investment of research and development dollars, were able to bring about major changes in systems approaches, and the replacement of the seven digit dial system with a nine digit dial. What would now be the state of the art in education if such financial resources and the commitment to improvement had characterized public education? Who knows: for education such a condition would be like living in another world.

Systems Analysis

Anybody who knows anything about education would have to grant immediately that Oettinger is right in saying that education is too complex to admit of anything like systems analysis. In fact, anyone who tries either naively to assume that systems analysis will work in the schools or tries to make others believe that it will, may be making an error that ranges from pure ignorance to deliberate fraud.

On the other hand, education has never tried a full-scale systems approach. From experience we really do not know that it could not have some good effects.

For example to speculate, what would have happened had the United States Congress, before authorizing the Elementary and Secondary Education Act, designed some kind of a national system of educational priorities? And suppose that the national system of priorities had taken two, three, eight, or ten years to tool up? And suppose they had worked out some kind of systematic design for educational innovation and development? And suppose instead of the U.S. Office of Education's getting proposals and allocating money they had in fact created an organization to which they gave money on the basis of some grand outline of job responsibility, task orientation and the like? In other words, suppose an R&D model of great magnitude and great specificity

also had been developed, what then might have been the ways in which Title I and Title III (Elementary and Secondary Education Act) money could have been spent? Would we have had the waste we have? Would we have seen more than the insignificant developments now growing out of these dollars? Well, maybe so, but no one will ever know because it was not done that way. Instead, we broadcast the money like grass seed on unprepared soil. We gave money to school people expecting that they had ideas or could develop ideas to make useful plans and programs. The strategy we used has not worked well, as all now agree, but we still do not know what the limits of a systems design might have been.

Individually Prescribed Instruction

For some reason, perhaps because of an inability to comprehend what is read, the term individualization never yields to definition in Oettinger's essay. The reader is treated to a round trip of both pathos and humor with a slight mixture of bias.

Not wanting to speak for the whole of individualization, I do feel somewhat responsible for at least correcting the view of Individually Prescribed Instruction (IPI).

The point is that IPI is more than a simple matter of taking some technological gimmick or another, some device, and changing something that is ordinarily done one way and doing it another. IPI requires some technology, but the technology is not IPI. IPI is a strategy. IPI is a different view of the way teaching should be done.

Run Computer Run presents the notion that you somehow play unfair with the promise of individualized instruction, because you do not allow for maximum freedom for "creativity." This is pure nonsense. IPI does NOT accept as intrinsic the notion that every child does exactly what he wants. This is simply not a part of IPI. That is not a part of the strategy. Whether that is a good strategy or not is another question. The IPI strategy does not require that every child be completely free to experiment, to do anything he wants to attain whatever end he wishes to attain. There is no necessary definition of individually prescribed instruction, or even individualization of instruction, which requires that the student be completely free to pursue his own ends. IPI's strategy says that the ends are known, that somebody does in fact prescribe the goals and that a student is supposed to reach those carefully defined goals. Indeed, it's a highly structured kind of strategy. The essay never comes to grips with that problem as a problem in those terms.

IPI is criticized because it does not meet the author's undefined criteria for what constitutes individualization of instruction. It could be argued, for example, that some concepts of individualization of instruction at some times in some subject areas might include ends which were defined strictly by the student himself. In other words, I have to reject the idea that maximum freedom is a necessary condition for something called individualization of instruction. It seems to me perfectly possible to define individualization of instruction in IPI terms, which is a highly structured curriculum in which the ends are stated behaviorally by somebody other than the student. It is a perfectly legitimate pedagogical condition.

And Finally Institutions

The truth of the matter is that a great many internal reforms need to take place in educational administration, the way schools operate, teacher education (both pre-service and continuing), and the way public policy is made for school systems. The truth is that every organization, at any point in time, exhibits a great deal that is wrong with it. That is true for education just as it is true for anything else.

Watertown is not the main issue anymore than the school or technology is the main issue. These are all symptoms of the illness described in Run Computer Run. Oettinger has made it patently clear that the real illness is education itself.

Only a fool would quarrel with the central themes of Run Computer Run. Academic games can be played with futile results, if one wants to carp about the limited sample of Watertown and Small City. This would, of course, serve no major purpose, since even an academician does not need to step very far into a barn full of "cows and bulls" to know what he is stepping into.

A real question of concern is how do we begin to reorganize our thinking and resources to make "tomorrow" happen?

TOWARD TOMORROW

One thing is certain: we do not have the luxury of waiting for tomorrow to happen. If tomorrow is going to be different from today, something different has to be started now. Right now our schools are preparing a new lost generation.

The urgency for rational action now may be more crucial than we even want to admit. The school population in our urban areas constitutes approximately 70 per cent of the total school population. All that we currently know about children who attend school in American cities would tend to confirm that as many as 50 per cent of the students are retarded at least a year and a half to two years in their educational growth. The number of such children approaches 15 million. This is the urgency. Is there a better reason to put a high premium on planning how to use technology in education?

Oettinger and the Harvard Program on Technology and Society do not really need a two-day conference to pick apart an exceptionally fine essay. What is desperately needed is a continuation of the final chapter.

I would like to suggest that we should exert our power for two days in focusing on reality and to think about what can be done to build, in a planned way, a new tomorrow, including today's and tomorrow's technology.

Several considerations are postulated in the remainder of this paper in the spirit of opening the conference for intellectual searches toward creative solutions. None of the ideas proposed is complete in itself. Premises are stated as a means of promoting discussion.

Regional Educational Laboratories

> Premise: The regional educational laboratories, given a realistic amount of time, some planned direction, vital leadership, and the proper amounts of money for educational development, will have a significant impact upon change in education.

The twenty regional educational laboratories, created to serve as educational developers, appear to be emerging as major inter-agencies capable of serving as an interface in accelerating the pace at which new applications are developed from the emerging technology. Lauren Carter, Senior Vice President of Systems Development Corporation, in speaking of the laboratories said:

> "The Federal legislation establishing the regional education laboratories may have been one of the most significant educational advances of our time because it helps assure a proper development and demonstration of the credibility of educational innovations.
>
> The primary purpose of the regional laboratory is not to undertake research per se, but rather to develop products and procedures that are of proven effectiveness and to facilitate their introduction and demonstration in various real school situations. The regional laboratories greatest services will be arranging for credible demonstrations of new techniques. The regional laboratory can stimulate local school personnel to try out new ideas and innovations to determine if they are applicable in the actual school situation and then use these demonstrations as examples for application in other school settings."[1]

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[1] United States Congress Joint Economic Committee, Sub Committee on Economic Progress, Technology in Education: Hearings on June 6, 10, 13, 1966. Wash., D.C. U.S. Government Printing Office, 1966.

Obviously, the laboratories have not been free of problems, nor should they be. Time, institutional growth, and inadequate funds have plagued the laboratories since their inception. In spite of six-month funding, ninety-day funding, and for some, nine-month funding, the laboratories are beginning to emerge as agencies capable of responding to the educational problems of a region and the nation. Some of the laboratories have begun to accept the challenges of educational technology.[1]

Evolving Change

> Premise: The most effective changes in education will be those which are well planned, implemented, and designed to exist in a continual state of change, thus never allowing for the institutionalization of a program as such.

The above premise is advanced on the grounds that new programs have a way of quickly becoming old programs. Typically, our schools have been designed for stability and preservation and not for rapid adaptation and change. If change itself can become an institutional characteristic, it is possible that we can break out of our colonial pattern. IPI represents a beginning experiment in this direction.

Several years ago a group of researchers from the Learning Research and Development Center (LRDC) invented Individually Prescribed Instruction (IPI). The birth of the program was in the Oakleaf School in a suburban community of Pittsburgh.

Two years ago Research for Better Schools, Inc. (RBS) in cooperation with LRDC developed a demonstration school and four pilot schools in a

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[1] See Appendix A for a brief description of their activities in technology.

selected three-state region. Today, twenty-seven schools are using IPI. In the school year 1968-1969 a minimum of seventy-seven schools with over 30,000 students from twenty-six states will be using the IPI math program.

At no time has IPI been billed as a panacea by either the inventors or RBS. Indeed, every school has been screened on the basis of stated criteria prior to admission in the program. All of the schools have been advised that the program is experimental, costly, and constantly subject to change.

One of the chief advantages of IPI has been this non-institutionalization. The consumers, teachers and pupils, are actively involved in continued educational development and have received the active support and resources of LRDC and RBS in changing and improving the paper and pencil mode of IPI.

Several other modes are also being developed in a limited experimental way. These are:[1]

Mode 2 - Automated Learning Management System (Instructional Management)

Mode 3 - Computer Assisted Instruction

Mode 4 - Interactive System

If and when these modes prove their worth, they will be field tested in our five demonstration schools prior to being implemented on a broader scale. The real point is that research and educational development have been wedded to the teacher and student in an effort continually to improve IPI programs.

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[1] See Appendix B for a general treatment of the four modes.

It should be noted that LRDC and RBS view IPI and the successive modes as an evolutionary approach to education as opposed to both revolutionary and "instant" changes in education. Enthusiasm should not be confused with myth and false promise.

Freedom of Choice

> Premise: The state has the constitutional responsibility to guarantee parents the freedom of choice in determining where their children will attend school.

The new realities of power are beginning to show the effects of public dissatisfaction and frustration with the traditional distributions of authority in public school systems. Countervailing forces are emerging, and it is these new forces that are seizing, in some places at least, the initiative to compel a reexamination of traditional governing principles. Militant teachers, not just the AFT incidentally, militant blacks and even militant students are not only challenging board and administrator authority, but even questioning the validity of their bureaucratic organization. For an organizational structure carefully evolved through the years to maximize stability and minimize risk the pressures of these countervailing forces are producing trauma of an exquisite sort.

A kind of ambivalence in big city school administration is becoming increasingly apparent. The immediate response to pressure is to resist, and to invoke all the old truths and ancient perquisites of legal power. But even so, the need to change is also apparent, even to the most hard-bitten of the old guard. So change they must. But change through the means of an organization designed to defend against change is very hard to do and the strains are opening big holes, through which the new forces are driving.

A most recent example of enormously pervasive implications is, perhaps unexpectedly, going on in Rhode Island. There nothing less than a bill giving parents a free choice of schools for their children was reluctantly defeated in the legislature. The language of the bill is worth reproducing at some length to make the point that there is no limit to the revolution in education. The revolution may even reach to the heretofore sacrosanct precincts of establishment power itself.

CHAPTER 48
"State Tuition Grants

16-48-1. Legislative findings - Declaration of Policy. - The general assembly being charged by the constitution of this state with the duty not only of promoting public schools but also of adopting 'all means which they may deem necessary and proper to secure to the people the advantages and opportunities of education' makes the following findings:

1. The public purpose of compulsory education laws is equally achieved whether the child is educated in a public or in a non-public school.

2. It is the inalienable right and responsibility of parents to determine the kind of school their child attends. The state of Rhode Island recognizes and encourages the rights conferred by the first and fourteenth amendments to the constitution of the United States including the right to know, freedom of speech, freedom of the press, freedom of assembly, the right to equal protection of the laws, and, desires to promote the freedom to learn and to pursue education.

3. The survival of democracy requires that the pluralistic value system be maintained. Elimination of non-public schools would result in a monolithic educational system and lead to cultural uniformity, destroy diversity in points of view, in standards of taste, and in value commitments. The general welfare of the state and common defense of the nation require that all children of the state without regard to race, color, creed or national origin be afforded the best quality education possible while their rights to freedom of belief and expression are protected."

4. Competition between the public school system and non-public schools tends to improve all education.

5. A crisis is imminent which could rapidly deteriorate the quality of elementary and secondary education in this state because of the threatened closing of numerous non-public schools due to mounting costs of instruction, materials and services. Since the closing of non-public schools would enlarge the public school enrollment by almost one-third, and since the cities and towns already depend on state allocations to maintain quality standards in education, the demands upon the funds of the state to support the additional cost of the education of such children in the public schools would be catastrophic and overwhelm the inadequate tax resources of cities and towns, and the need to minimize the tax burden upon all the citizens would be a threat to the quality of education which the public schools are now able to offer.

Therefore, the general assembly declares that the welfare of all the citizens of Rhode Island and the financial well-being of the state and its cities and towns demand that the state make annual tuition grants to parents and guardians of children attending non-public elementary and secondary schools to defray part of the cost of educating such children as required by law."[1]

Imagine what would happen if the weaknesses of the above bill were changed and the bill was passed. Black children from the ghettos could attend schools in the suburbs. What a shock this would be to our stratified Puritan culture.

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[1] House Bill 1462, State of Rhode Island and Providence Plantations, January Session, A. D. 1968, printed February 21, 1968. pp. 1-3.

A National Organization for Educational Development[1]

> Premise: Educational innovation and development is a big expensive job which needs specialists and money in great amounts; and, perhaps even more importantly, needs systematizing. It needs a special organizational structure. To depend in some naive way upon local school districts to bootstrap themselves into excellence is not only futile, it is foolish.

The essence of any plan for creating a central intelligence for educational development in American elementary and secondary schools is to distinguish between a national organization and a federal one. A national organization certainly requires that some voluntary delegation of power and financial support come from the independent local (as well as private and church-operated) educational jurisdictions so that a representative authority can be created and maintained. Provided that adequate operational safeguards are established such a centralized (national) organization can be controlled by its membership, and thus preserve rather than threaten the integrity of the home rule principle. A federal centralization structure is actually neither representative of nor controlled by local jurisdictions, of course.

Important as political integrity for local school jurisdictions is, a national organization has another great advantage over a federal bureau: the vastly greater potential support in money and manpower it can generate. Anyone who is familiar with the educational history of the last several years

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[1] This concept has been expressed and submitted for publication by Dr. Leon Ovsiew, Assistant Dean of Education, Temple University. In the expanded version Ovsiew develops the anatomy of a national organization including the functions, operating agencies, structure, funding, and relationships to other institutions.

knows how difficult it has been for USOE to command the money which was necessary to the care and feeding of the educational research and development function which it was wise enough to initiate. USOE, and quite probably Congress, cannot be faulted for a lack of initiative and insight into educational needs. But federal money has been, and always will be, hard to get for certain educational operations. The reasons why are subtle and need not be explicated here, but no one who is at all conversant with federal operations in education is likely to claim that educational research and development will ever be a top federal spending priority.[1] There is a much better, and a more logical, chance that federal monies for program support will continue to increase at a gratifying rate. That kind of support is - and will be - a high federal priority.

But a national organization, owned and controlled by local jurisdictions, will be able to increase R&D expenditures at least ten-fold with only modest support from its membership. This result of voluntary cooperation is, of course, a vital difference.

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[1] Indeed, an interesting, and inevitable, phenomenon occurs at the federal level when money demand for research exceeds supply. In the effort to conserve funds the federal agency must itself decide upon priorities. Once this occurs, the move toward federal control begin to gather force.

And Finally

As stated earlier, the primary purpose in generating some premises was to evoke discussion which might serve as useful inputs for the final section of the essay Run Computer Run. A lot of avenues remain to be explored. Perhaps we can avoid the mistakes of today if we keep the following quote in mind:

> The point is that magic is terribly literal-minded. It will give you what you ask for, not what you should have asked for, nor necessarily what you want.[1]
>
> ...Norbert Weiner

As evidence of my own willingness to venture into a yet uncharted tomorrow and to run the risks that Weiner warns against, let me suggest what seem to me to be some of the right questions. And let me emphasize that although these are tomorrow's questions they must be considered now. For what they may suggest for our discussions, here are some of my questions:

- How far would we be willing to go in devising a centralized national structure to systematize and coordinate the research and educational development function?

- Is it reasonable for us to plan how to recast the organizational structure of local education agencies (school systems) so that the structure could contend with problems and pressures?

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[1] Martin Greenberg (ed.), Computers and the World of the Future, Cambridge; The Massachusetts Institute of Technology, 1962. Page 24.

- Can our political democracy adapt itself to the apparently chaotic and antithetical publics which now wish to have direct access to the decision-making powers of educational government?

- Even granting the illogic of applying systems analysis to the total educational enterprise, what probability of success is there in applying systems analysis to the economics of education? What hope is there, in other words, for creating a financial support program that will provide as much money for education as can be wisely spent; that is, spent according to a plan?

- Is there any reason to believe that a working partnership which will defer financial profit can be worked out between school systems, federal and state governments, and the education industry? Can the education industry invest R&D capital in technology even though it would take years for its consumers to be able to buy and use the products?

- What kind of organizational relationship among those who work in and for the educational enterprise can be devised so as to develop strategies and applications of new instructional modes, which are not only more effective in teaching and learning, but more economical of the scarce resources existing in the educational enterprise?

APPENDIX A

TECHNOLOGICAL BEGINNINGS

OF THE

REGIONAL EDUCATIONAL LABORATORIES

INDEX TO A LISTING OF LABS[1]

(AEL) Appalachia Educational Laboratory, Inc.
P.O. Box 1348
Charlestown, West Virginia 25325

Benjamin E. Carmichael, Director

(CUE) Center for Urban Education
33 West 42nd Street
New York, New York 10036

Robert A. Dentler, Director

(CAREL) Central Atlantic Regional Educational Laboratory
1200 Seventeenth Street N.W.
Washington, D.C. 20036

C. Taylor Whittier, Director

(CEMREL) Central Midwestern Regional Educational Laboratory
10646 St. Charles Rock Road
St. Ann, Missouri 63074

Wade M. Robinson, Director

(CERLI) Cooperative Educational Research Laboratory, Inc.
540 West Frontage Road
Northfield, Illinois 60093

David M. Jackson, Director

(ERIE) Eastern Regional Institute for Education
635 James Street
Syracuse, New York 13203

N. Sidney Archer, Director

(EDC) Education Development Center, Inc.
55 Chapel Street
Newton, Massachusetts 02160

Arthur L. Singer, Jr., Director

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[1] On the following pages information is presented by using each laboratories own alphabet soup. For example, RBS as identified in the list is Research for Better Schools, Inc.

(FWREL) Far West Laboratory for Educational Research and Development
1 Garden Circle, Hotel Claremont
Berkeley, California 94705

John K. Hemphill, Director

(MOREL) Michigan-Ohio Regional Educational Laboratory
3750 Woodward Avenue
Detroit, Michigan 48201

Stuart C. Rankin, Director

(McREL) Mid-Continent Regional Educational Laboratory
104 East Independence Avenue
Kansas City, Missouri 64106

Robert S. Gilchrist, Director

(NWREL) Northwest Regional Educational Research Laboratory
400 Lindsay Building
710 S.W. Second Avenue
Portland, Oregon 97204

Lawrence D. Fish, Director

(RELCV) Regional Educational Laboratory for the Carolinas and Virginia
411 West Chapel Hill Street
Durham, North Carolina 27701

Everett H. Hopkins, Director

(RBS) Research for Better Schools, Inc.
121 South Broad Street
Philadelphia, Pennsylvania 19107

James W. Becker, Director

(RMEL) Rocky Mountain Educational Laboratory, Inc.
1620 Reservoir Road
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TECHNOLOGICAL BEGINNINGS OF THE REGIONAL EDUCATIONAL LABORATORIES[1]

For the purposes of presentation, I have grouped the accomplishments in technology into three arbitrary categories. Of course, most people know that categories exist for the convenience of the categorizer - and most categorizers will die from hardening of the categories. In any event, the groupings are:

(1) Non-Computer Technology - Devices not requiring a computer in order to operate.

(2) Computer Instructional Technology - Developments in the use of the computer for instructional purposes.

(3) Computer Administrative Technology - Developments in the use of the computer for administrative purposes.

Non-Computer Technology

A review would indicate that the laboratories are making extensive use of radio, television, audio video tapes, recorders, microfilm, and movie film. In addition, a model auto-tutorial lab has been developed for teacher self-instruction in the use of new science curriculum (UMREL).

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[1] The following information needs to be updated. This will be done in a revision of the manuscript.

Some areas in which the "devices" have been used include:

- Teacher education (general) (CERLI)
- Studies of teacher behavior (MOREL, et al.)
- Studies of pupil behavior (Several)
- Studies in linguistics for Spanish-American pupils (SWCEL)
- Mini-courses for teachers on the skills for individualized instruction (FWREL)
- Studies of teacher/pupil interaction (Ten Laboratories)
- Studies of mass media (CUE)
- Film/tape programs for teaching the construction of behavioral objectives to teachers. (SWCEL)

A sampling of the above areas are:

(1) The Center for Urban Education has been conducting a study of mass media to obtain answers to two fundamental questions: how can the mass media promote images of the educational system (New York) that will, in turn, promote desired educational outcomes; and, how can the mass media, by educating children and their parents, promote a classroom learning situation most conducive to literacy?

(2) The Northwest Regional Laboratory, in a direct attack on the problems of rural and isolated schools, has developed multi-media self-instructional systems in speech, electricity-electronics, plastics and welding. Such strategies are designed to bring a better quality of education to areas which are facing extreme shortages of qualified teachers.

Computer Instructional Technology

Six of the laboratories have planned for or are conducting developmental activities in the use of the computer for instructional purposes. The activities by laboratory are:

- South Central Region Educational Laboratory - has been field testing the Suppes computer-assisted math program with rural Negro students.

- Southwest Educational Development Corporation - has initiated a two-pronged program to provide:
  (1) education and training of personnel in local schools to familiarize them with the new technology.
  (2) introduced computer-assisted instruction into the classrooms of the region. Five remote terminals have been used for pilot work in developing elementary and secondary mathematics; testing the materials with students; and, developing elementary spelling materials.

- Northwest Regional Educational Research Laboratory - the activities have included the development of teacher automated guides which provide information to help teachers design educational experiences for elementary school students. Included in the system are data about the student's background and achievement and science curriculum information. Computer-assisted instruction is being developed in mathematics including sequences in fractions, decimals, percent, ratio and proportion as well as 20 units of vocational mathematics. The system has been field tested at Endicott, Washington and is being installed this fall at Cascade, Idaho; Victor, Montana; and Anatone, Washington.

- Central Midwestern Regional Educational Laboratory - specific activities have been conducted to determine the educational uses being made of computers in the region. In addition, a study has been completed to determine a preliminary design for a flexible modular student terminal. Comparisons of dial-access information retrieval systems and computer-assisted instruction systems are underway.

- Research for Better Schools - has developed a 4-pronged attack on the problem of the use of computers in instruction. Defined as "Modes", developmental activities have continued from Mode I, Individually Prescribed Instruction, as invented by the Learning Research and Development Center at Pittsburgh. Mode II, Automated Learning Management, has been started by collecting and reorganizing data collected from Mode I. The ultimate aim of Mode II is to develop a system of information for teachers to assist them in Individually Prescribed Instruction. Mode III, the Computer-Assisted Instruction Mode, has been started with the computerization of the IPI math placement tests in cooperation with the Philadelphia School District on the Philco-Ford SAVI equipment. Mode IV, the Interactive Mode - preliminary investigations have been made to search out and modify programs and techniques which have the potential for meeting the challenge of humanizing education.

- Southwest Regional Educational Laboratory - formulation and prototype design have been completed for the initial model of the Computer-Managed Instruction system (Model 1 IMS). Additional activities have included the documentation of observations and procedures during the formulation period, and the

preparation of the prototype User's Guides. The first evaluation will take place in the school term beginning in the fall of 1967. During the semester the programs will be applied to four classrooms, two in Roosevelt Elementary School and two in Brentwood Elementary School. Procedures have been developed to carefully monitor the first cycle of Model 1. These procedures provide for the collection of base-line performance data including such measures as: the reliability of the computer program and associated equipment; the frequency of use by teachers of the computer outputs (pupil performance record, teletype displays, etc.); and the amount of use of prescribed remedial materials.

Computer Administrative Technology

The activities related to the use of the computer for administrative technology are varied and thus more difficult to treat under a single category. However, 50% of the laboratories have made starts in an area that could be best characterized as developing decision-making tools.

A major goal that does provide a common thread appears to be "How can superintendents of schools be given better data more quickly from which they can make decisions relevant to the daily, planned, and projected programs for their schools?"

Activities here include:

- educational planning
- personnel planning
- program budget planning
- information files
- management information
- research planning
- evaluation and analysis
- problem-solving (these computer applications are also used for instructional purposes with students)

Implications

In a relatively short period of time, the laboratories have focused on one of the more critical areas of education, technology.

The best of our technology will never succeed unless the problems of utilizing technology are studied from the human side - the users. Several laboratories have focused on the problem and have organized the functions of their laboratory to provide for all of the aspects of what some people call engineering. The ERIE laboratory is a good representative of this focus and is concerned with all of the engineering aspects of building prototype school systems.

Implications for the work being conducted in technology by the laboratories are far reaching and should have long-range effects on the following:

(1) School Organization
(2) Administrative structures of school systems
(3) The changing role of the teacher
(4) The role of guidance
(5) Student subject progress and mastery
(6) Instructional materials and devices
(7) Changing the structure of teacher education into the behavioral sciences professions
(8) The cost effectiveness of education
(9) Theories of learning
(10) Priority needs for basic research

The promise is great, but as yet it remains a promise. The problems confronting education will not yield fast solutions, nor can they be resolved with a pauper's budget that turns on again/off again in periods of short term commitments. Laboratories, if they are to succeed at an optimum level, will need long-range commitment and support.

APPENDIX B

TOWARD AUTOMATED LEARNING

TOWARD AUTOMATED LEARNING*

by

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* This paper was delivered at the American Educational Research Association Annual Meeting, February 8, 1968 in Chicago, Illinois.

TOWARD AUTOMATED LEARNING

The word symposium has been aptly defined as a conference where opinions are discussed and gathered on selected subjects. Since opinions are free, a symposium should move readily toward open discussion.

At the outset of this paper, several things need to be stated in order to set a stage that will enable the listener (or reader) to avoid misunderstanding the direction of the paper, as well as the common mission of Research for Better Schools, Inc. It is intended that the paper will treat in a general way the following major points, each of which will be traced in successive steps:

Mode 1 - Individually Prescribed Instruction - the break from the traditional classroom setting

Mode 2 - Automated Learning Management System

Mode 3 - Computer Assisted Instruction

Mode 4 - Interactive System

Research for Better Schools, Inc. (RBS), one of twenty regional educational laboratories, has as its major mission the individualization and humanization of learning. It is readily conceded that the mission is large and the definitions at times fuzzy. Nevertheless, RBS has made major beginnings in each of the above four modes.

Mode 1 - Individually Prescribed Instruction (IPI) is a major break from the traditional classroom setting. Indeed, at stake is a completely new instructional role for the teacher. All too often in the past the teacher has served as the final authority and as a dispenser of information to students. In contrast, IPI is organized so that the teacher becomes an organizer of a system for instruction,

a diagnoser of learning problems, a prescriber of instructional remedies, and a coordinator of educational helps to the learner.

Perhaps an over exaggerated definition of IPI would be to state that it is the utilization of humans to simulate in a manual paper mode that which can be accomplished by the computer and the best of our automated technology.

Little doubt remains in the minds of those who have invented and experimented with IPI that we are talking about an evolutionary approach in education,(1) an approach which ultimately will take full advantage of research and development techniques as well as the emerging technologies.

The best published operating description of IPI was contained in the 1966 Yearbook of the National Society for the Study of Education, Part 2 - as written by two of its inventors, John Bolvin and Maury Lindvall from the Learning Research and Development Center at the University of Pittsburgh. The following remarks are abstracted from the operating principles developed by the above authors.

Individually Prescribed Instruction is an example of the application of the principles of programmed instruction to curriculum development in the elementary schools. This leads to certain basic assumptions underlying the IPI theory.

1) IPI is the idea that learning is something that is ultimately personal and individual - learning takes place only on an individual basis.

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(1) Glaser, Robert. "Adapting the Elementary School Curriculum to Individual Performance." Address delivered at the 1967 Invitational Conference on Testing Problems, New York, 28 October 1967.

2) Curriculum sequences must be developed in such a way that they represent a long term development process which ignores guidelines.

3) If pupils are progressing individually, questions about grouping, classification, or housing are irrelevant.

The following eight points were critical in the Implementation of Essential Structural Elements of Individually Prescribed Instruction:

1) A first step in the development of a program must be the clear and specific definition of the objectives that the pupils are expected to achieve.

2) The development of a program requires that the behaviors that lead to terminal behaviors are carefully analyzed and sequenced in a hierarchical order such that each behavior builds on the objective immediately below it in the sequence and is prerequisite to those that follow it.

3) The actual instructional content of a program consists of a sequence of learning tasks or activities (e. g. , frames, steps), through which a student can proceed with little outside help, and provides a series of small increments in learning that enables the student to proceed from a condition of lack of command of the terminal behavior to that of command of it.

4) A program permits a student to start at that level at which his present ability and achievement indicate that he is functioning and permits him to move on from that point.

5) In the use of a program, each pupil can usually proceed independently of other students and can learn at a rate best suited to his abilities and interests.

6) A program requires active involvement and response on the part of the pupil at each step in the learning sequence.

7) A program usually provides for rather immediate feedback to the student concerning the adequacy of his performance on each frame or element in the program.

8) A program is subjected to continuous study by those responsible for it and is regularly modified in the light of available evidence concerning pupil performance.

At the present time, Research for Better Schools, Inc., working closely with the Learning Research and Development Center, has been field testing the IPI Math system in 27 schools across the country. To date there are problems still needing resolution but the basic assumptions of IPI as originally invented have been proven sound.

By way of summary the IPI Math Program contains over 400 instructional objectives, placement tests, pre-tests, curriculum content materials, and post-tests. The subjects of reading and science are also underway.

Mode 2 - Automated Learning Management System

Several papers are being presented at this symposium dealing with instructional management systems. While the strategy for arriving at such systems, and the terminology as expressed by various authors may differ, Research for Better Schools has indeed started down this trail in cooperation with the Learning Research and Development Center. RBS uses Automated Learning Management Systems (ALMS), because we need more money. In reality we are dealing with the management of instruction.

Data has been collected on approximately 8,000 children, both experimental and control, in order to develop the full utilization of a computer terminal for the

classroom teacher. Two broad areas of concern are at the base of developing such a system: how do teachers make prescriptions for youngsters? how do teachers diagnose the learning difficulties that youngsters may be having. Hopefully teachers will begin to ask pertinent questions about youngsters and researchers will develop the necessary information files for the teacher.

Achievement tests offer us a systematic way of looking at a student's behavior. Administrators, teachers, guidance counselors and many others all employ test results in some way for the general purpose of improving instruction. The kinds of evaluation each group seeks answer different questions. Some ask, "How good are the schools in the Nation?" This is national assessment. Others ask the question, "How does my school district compare with similar districts?", to get information for the community and Board of Education. A question such as, "What has been the trend for the last five years in pupil achievement of social studies?", helps in identifying areas requiring improvement.

The above questions are very different from the kinds asked by the classroom teacher. Measuring educational outcomes and comparing the results with regional norms or national averages are not very useful to a teacher in a classroom with thirty plus very different students.

The teacher asks:

1. What can this student do?
2. What are the things he cannot do?
3. How is he progressing in his assigned work?
4. What difficulties is he encountering in his assignment?

5. What is the evidence that he will experience success in his next assignment?
6. Is he ready to learn something new?

The student himself uses testing to answer his questions:

1. What am I supposed to learn?
2. How am I doing?
3. What is giving me trouble?
4. What help must I ask for?
5. Can I do this as well as everybody else?

Answers to these questions can be extraordinarily helpful to the teacher in guiding the educational development of the student and in measuring the effectiveness of instruction. Students are motivated by the answers which frequently function to establish a readiness and receptivity to learning something new. This information also helps the student increase his independence in working towards a well-defined target.

It is obvious that the test instruments used for national assessment, district comparisons, and trend studies are completely irrelevant to the questions of the teacher and student. These questions can only be answered by a work sample.

A classroom test is a work sample of all the behaviors the student must master in a given curriculum or a part of the curriculum. Student performance on this sample enables the teacher to generalize concerning progress and mastery in the portion from which the sample is drawn. Before such generalizations can be made, the classroom test must constitute a fair and representative sample of behaviors to be mastered. Unless this is the case, the test will not answer

questions about student progress. Also, it may well leave the students thoroughly confused about what they are to learn, what they are learning, and if they have learned at all.

No tests dictate what to teach. Instead, our learning goals, instructional objectives, behavioral objectives (whatever they may be called) tell us what we want to test. Each behavior to be mastered demands a suitable test or test items specially designed to measure that behavior.

Once this matching of work samples to behaviors is done, the classroom test becomes a powerful tool for diagnosing the learning needs of the students. The teacher then can place the students accurately in the curriculum, analyze the specific skills he needs to learn, monitor his progress, and determine his mastery. These four uses of the classroom test give the teacher a basis for choosing specific instructional resources to help the student master the desired behaviors.

The computer becomes a most persuasive tool in providing fast feedback to the teacher about the learner. It should be noted that this is a logical transitional state as a direct outgrowth from the existing paper model of IPI.

Mode 3 - Computer Assisted Instruction

Research for Better Schools, Inc. is in the process of computerizing the IPI Math Program. The first stage of work involves the programming of the Math Placement Tests, followed by the pre-tests, the instructional content, the curriculum embedded tests, and the post-tests. Utilizing the Philco-Ford Student Audio Visual Interface system which is currently located in four junior high schools in the Philadelphia School District, RBS has addressed itself toward the role of the computer in the presentation of information aspects of instruction.

There are some who believe that testing in and of itself is an instructional procedure. A number of outcomes hopefully will be achieved as a result of this undertaking. Perhaps the most significant outcome will be one of finding out the effects of testing on deprived junior high youngsters.

I would be remiss in not pointing out that computer assisted instruction as it generally exists across the country reaches only two levels of learning. Level one learning can be best categorized as doing something that cannot be replicated again. Indeed, you influence something so it is different after that. Obviously, this is a low level of learning. Learning level two is the process in which you change something so that you can add more or do it faster. A piece of rock or a magnet can do learning one. Animals can do learning two. From our psychological studies of learning, and most of the computer assisted instruction programs that exist in America, we have ample evidence to prove that you can take a human being and teach him to learn like an animal.

A third level, learning to learn to learn, - it can be learning to learn not to learn - is more difficult.

Mode 4 - Interactive System

At the present time, the state of the art in both technology and knowledge is of such a nature that Modes 1, 2 and to some degree 3, can be carried out, and indeed are being investigated by any number of researchers across the country. At RBS we are working on all three modes and see the interrelationship of moving in these directions.

Many researchers tend to marry Mode 2 (instructional management) and Mode 3 (computer assisted instruction). Since it has been reasonably demonstrated that

programmed texts can work there would appear to be some wisdom in separating modes 2 and 3 at least for purposes of research; although strong arguments can be built for separation, sequential, or the merging of both modes.

One could logically end a presentation with the three modes described, but this really is not the end of the RBS story. It would be a waste of resources and knowledge not to enter Mode 4 - the Interactive System.

The challenge of the interactive mode is to make the computer so reactive to the child that it becomes unique to him. What's more the content presented to the learner will consist of more than arithmetic, reading, spelling and the like.

Our aim should be to teach beyond the rock and Pavlov dog level. The learner should be exposed to the processes of learning, which in reality represents learning to learn to learn. Long after the information accumulated in our too typical learning environments is forgotten, the learner could remember the processes.

It is not unrealistic to expect that we can teach youngsters to interact in the solution of problems concerning self, vocational career choices, academic guidance, curriculum choices and the like. The techniques for such undertakings may well come from computer assisted instruction and the data from instructional management systems.

RBS has begun an intensive search for measuring instruments and content materials for the interactive mode. To date we have found a dearth of available materials. A restricted printing of twenty-six major interactive instruments has been published by RBS. Entitled "Mirrors for Behavior," it is our entry

into extending the frontiers of knowledge and experimentation.

In concluding several points are worth mentioning.

1) No magic wand is going to produce instant changes in education. Unless management practices in school administration and the social mileu of the schools are changed one could seriously question if any fruitful change can take place.

2) As one moves from Mode 2 through Mode 3 the need for more basic research becomes quite apparent. We cannot afford to live in an either or world. Money, in much larger quantities than in the past, must be allocated to cover the total spectrum of research and educational development.

3) As new roles emerge more accurate definitions and job descriptions will become necessary. Human engineers, educational technologists, educational developers, and goodness knows what other emerging roles are going to need newly defined disciplines. Universities will be forced into accepting these new disciplines.

Finally, let me remind you that a symposium is a collection of opinions. Hopefully I have not deviated from the definition.